

# Risks of Hurricane Taming

By Joshua Lederberg

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THE TECHNOCRAT'S basic sin, according to the modern demonology, is his oversimplification of human problems for the sake of elegant analysis. He may then impose his well-intentioned but short-sighted solutions on an unsuspecting and helpless public. To be sure, he may also be motivated by avarice, power-hunger, excessive idealism or moral cowardice—but these attributes are not special to those humans who have technical expertise.

Having been tenderized by critical attacks in this style, the more conscientious technocrats today may be ensnared by the opposite vice of technophobia, a paralysis of thought and action that may lead to needless waste of people's energies or lives. The most critical examples of this surrender may be happening in medical experimentation and drug development. Here excessive prosecutory zeal over minutiae (like a recent furor over blood tests for the XYY chromosome type) merely obscures large-scale abuses (like the unhindered distribution of common tranquilizers and other drugs still not properly tested for injury to chromosomes) and frustrates research with considerable humanitarian potential.

A good example of a potential conflict between politics and technology is emerging in the field of hurricane control. This is a byproduct of efforts at "scientific rainmaking" which have had an ambiguous success over the past 25 years. They will certainly be bound to pose many irksome questions—mainly centered in the law of property rights in the weather when this does come under engineering control. The whole matter has been analyzed with great sensitivity and skill in a report by D. W. North (project leader), D. W. Boyd, R. A. Howard and J. E. Matheson of Stanford Research Institute. Their analysis forms part of a scientific review initiated by Dr. Myron Tribus, onetime assistant secretary of commerce for science and technology.

## Limited Trials

FOR THE PAST several years, a limited number of trials have sought to influence the progress of tropical hurricanes by seeding them just outside of the eye with silver iodide particles spewed from aircraft. In this "Storm-fury" project only storms judged unlikely to reach the mainland were seeded, in order to avoid charges of damages by premature intervention. This restriction sharply curtailed the experiments: Only three hurricanes were seeded between 1961 and 1969. The seeding, according to theory, provides nuclei on which supercooled water in the storm cloud can freeze, releasing considerable heat. This in turn creates peripheral drafts which can diffuse the energy of the storm.

Changes in wind patterns, in agreement with the theory, were observed in all three cases. However, hurricanes are notoriously variable, and many meteorologists doubt that the effect of seeding has been proven. The Storm-fury project personnel felt the evidence supported a 50-50 case that the seeding had been effective in a useful direction; they assigned very low odds to the risk that a seeding would aggravate a particular storm, which would

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The eye of a hurricane, from space.

be contrary both to the theory and to the findings in these few cases.

It would be easy to advocate operational experiments, or efforts to temper hurricanes that threatened coastal cities, if we were closer to scientific certainty about the outcome. The ethos of the laboratory calls for cautious diffidence about unproven propositions. Better to try and try again until we're sure!

This may, however, be an example of technophobia. Decisions are constantly demanded of our statesmen where the risks are far less amenable to scientific analysis than in hurricane control. We might hope for a better standard than the world's records in, say, military or foreign policy; is the batting average there as high as .500? Regardless, choices of policy under uncertainty are a democratic rather than a technocratic responsibility. It is the technocrat's task to assay and to expose the magnitude and uncertainties of the risks to the best of his ability.

The Stanford Research Institute report points out that U. S. property damage from hurricanes averages almost \$500 million a year. (With adequate warning and evacuation, at additional costs, no lives need be lost; however, the inconvenience and economic disruption of such precautions is a further charge). If we had to wait, say another 10 years, to reach a state of perfect scientific assurance about the usefulness of seeding, we might look back with chagrin on the waste of the intervening decade. Or we might have wasted our hopes and a few million dollars' worth of silver iodide. There is a very small chance that a storm would be objectively worsened.

Perhaps worst of all, the natural variation in storms might result in worse damage than was expected before seeding—which could sometimes happen even if the seeding were beneficial. Such a mishap would blacken the reputation of all meteorologists, generate endless recriminations against the government, and perhaps paralyze all future storm-modification research.

The field of decision analysis is a systematic parsing and summing of the odds of all the contingencies according to the best available knowledge. The decision analysis of the advantage of seeding, with the present information, indicates an expected reduction of damages of about 20 per cent. This is to say that we throw away an average of \$100 million in preventable storm damage every year that we neglect these opportunities. How precious is that greater certainty that might be gained from further trials!

Dr. North and his colleagues suggest serious consideration of operational trials, in spite of present uncertainties. Those who doubt that seeding influences the storm at all might judge there was little to lose except for the political risks.

## Political Decisions

THE POLITICAL RISKS are, however, very great—and they may require more sophistication in achieving honest understanding and commitment by the public than we know how to arrange. And the greater the scope of the human tragedy at stake, the worse the risks in this, as in other reaches, of politics.

Suppose, for example, that the catastrophic cyclone that struck East Pakistan last November had been successfully tempered, to the extent of saving 100,000 lives, an incredible humanitarian triumph. Still, would technocracy, having once intervened, been spared an indictment for genocide of the remaining 500,000 victims? And if the storm had swerved to the west, would the blow not have been perceived as a malicious act of meteorological warfare?

In a context of profound social disorder abroad any intervention is perilous; but we should manage better at home. Or should we allow the technocrats the luxury of perfect knowledge before action? Some form of plebiscite might be thought of for the storm-threatened populations of the eastern seaboard. However, traditional styles of political representation have not yet faced the challenge of making responsible commitments for or against the gamble.

The public certainly deserves the benefit of better knowledge that can be gotten by further research; it also deserves to know what odds of benefit or harm are on the tote-board today. Unfortunately, this is not a private investment that each citizen can make for himself, any more than we can bargain with each taxpayer about how much he personally wants to shell out for national defense or social welfare, and what his benefit will be from it.

The problem of reaching competent political decisions on weather control is bound to enlarge in the next few decades. The answer to operational seeding of hurricanes today may be yes, may be no. In either case, we need to develop and exercise the requisite machinery for "informed consent" without much more delay.

We see that standing by in the face of incomplete knowledge must come from as onerous a burden of decision as for affirmative action. This may be one of the deepest resentments of the mass culture against the technocracy—less that decisions are being made without consultation, rather that new technical opportunities demand that we make painful decisions once left to the will of the Furies. The strain on moral and intellectual fiber may be more than man can bear.

Not elision re drugs.